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The solid waste management practices at the foundry of the Cincinnati Milling Machine Company were studied for one week in October 1968. The sources of process solid waste generation were the cupola, the sand reclamation system, and the settling basin. During the study week, the cupola generated 84 cu yd of slag and sand waste, and the settling basin generated 42 cu yd of sludge. Waste storage within the foundry consists of open containers, closed containers, and open storage on the ground. Wastes are collected and transported daily to three landfills in both covered and open vehicles. These waste management practices were found to adequately remove the wastes from the foundry area.

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SOLID WASTE MANAGEMENT

PRACTICES IN A FOUNDRY

A Division of Technical Operations
Open-File Progress Report (T05/0)

written by
Michael L. Senske, Agricultural Engineer

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
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SUMMARY

The solid waste management practices at the foundry of the Cincinnati Milling Machine Company were studied for one week in October 1966.

The sources of process solid waste generation were the cupola, the sand reclamation system, and the settling basin. During the study week, the cupola generated 84 cu yd of slag and sand waste, the sand reclamation system generated 136 cu yd of sand waste, and the settling basin generated 42 cu yd of sludge. A general cleanup produced an additional 28.5 cu yd of wastes per week, bringing the weekly total to 280.5 cu yd. This total does not, however, include wastes from the foundry office or food service area, since these locations were not studied.

Waste storage within the foundry consists of open containers, closed containers, and open storage on the ground. Wastes are collected and transported daily to three landfills in both covered and open vehicles. These waste management practices were found to adequately remove the wastes from the foundry area.

The Cincinnati Milling Machine Company produces a variety of machine tools. The foundry, which employs 800 people, makes large castings used for manufacturing these machine tools. The foundry operation begins by shaping sand in molds. Molten iron from the cupolas, which generates a slag waste, is poured into the molds and allowed to cool. After the iron has solidified and cooled, the casting is removed from the mold and the sand is cleaned and reclaimed. Waste sand from the reclamation process is a major portion of the total waste produced at the foundry.

Once the sand has been shaken loose from the castings, the castings are trimmed, sanded, and painted. The finished castings are then sent to the machine manufacturing area where they are used to make machine tools.

METHODS AND PROCEDURES

A two-man team studied the solid waste management practices of the foundry for a total of 9 man-days. During a 6-day period, one man gathered information on the quantities and characteristics of the solid waste produced and on storage, collection, and disposal practices. The other member interviewed the foundry's administrative personnel for background information on plant operation and solid waste practices. The interviews yielded little because most of the information requested was either proprietary or not available.

Since the foundry did not have scales, quantitative data on solid waste generation was recorded in cubic yards. In order to develop a factor to relate volume to weight, two truck loads each of cupola wastes and sand reclamation wastes were weighed and their densities determined. No densities were determined for the settling basin sludge wastes because the condition of the Dempster Dumpster would not allow traveling to the distant scale site.

RESULTS

Waste Generation

The cupola generates slag at the molten iron-atmosphere interface. A skimmer continuously removes the slag waste from the top of the cupola to a tapered slag pot. An overhead crane then picks up the slag pot and carries it to a waste storage area near the cupola. In addition to the slag wastes, a small quantity of waste sand from the refractory lining of the cupola doors is collected when the cupola is emptied for the weekend. The total slag and sand waste from the cupola amounted to 84 cu yd, or 93 tons during the study week (Table 1).

The sand reclamation system (Figure 1) processes the sand from the molds and the casting "shake-out," an operation where the castings are shaken to remove any loose sand clinging to them. Two forms of sand wastes, clumpy and fine, are generated at the final screening. The weekly total from the sand reclamation system was 126 cu yd or 164 tons.

Particulates from the various operations of the foundry are removed from the atmosphere by several large cyclone air filters. The collected particles are then carried to a settling basin by a water carriage system. The particulate matter settles out and forms a sludge, which is then pumped through a centrifuge. Here it is partially dewatered and pumped into storage containers. The sludge waste amounted to 42 cu yd.

TABLE 1

PROCESS WASTE GENERATION DURING STUDY PERIOD
(September 30 - October 5, 1968)

(Cubic yards)

Day	Source and Type of Waste				
	Cupola (Sand and slag)*	Sand reclamation system (sand)+	Settling basin (sludge)	Biweekly cleanup (sand and sludge)	Total
Monday	19.2	21.6	9	---	49.8
Tuesday	28.8	16.2	9	---	54.0
Wednesday	12.0	28.8	6	---	46.8
Thursday	12.0	17.4	9	---	38.4
Friday	12.0	42.0	9	---	63.0
Saturday	---	---	---	28.5	28.5
Total	84.0	126.0	42	28.5	280.5

* Density equals 2,200 lb per cu yd.

+ Density equals 2,500 lb per cu yd.

LARGE CASTINGS AND
ALL MOLD SAND

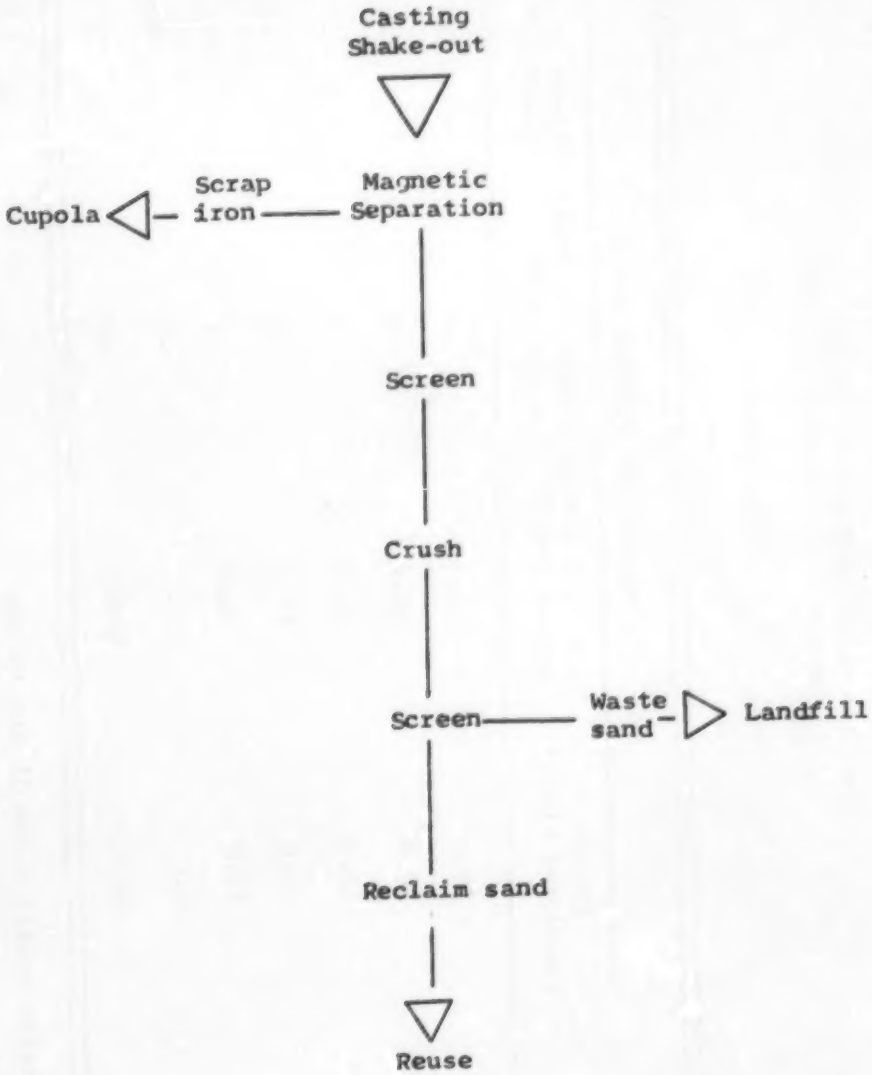

FIGURE 1. Sand Reclamation System.

In addition to the three major sources of wastes, a biweekly cleanup of the foundry generated 54 cu yd of sand waste and 3 cu yd of sludge waste, or 28.5 cu yd per week.

Waste Storage

There are three major sources of waste storage. An overhead crane dumps the semi-cooled slag wastes from the slag pots onto a dirt area where they are further cooled before collection. The storage area is adequate in size but lacks neatness and orderliness.

The waste sand from the sand reclamation process is conveyed to rectangular metal bins (approximately 3'x4'x5') for storage. The containers are constructed of heavy material and are rusty, dented, and bulky. Because they have rigid legs instead of wheels, an overhead crane is necessary to move them. The same containers are also used for storing scrap from other areas of the foundry. Size of the storage area for the bins is undefined and varies according to the number of containers in use. The storage area can include any area beneath the overhead crane.

Sludge wastes from the settling basin are stored in 3-cu-yd Dempster* containers. These containers are difficult to handle because of their weight, but they do have wheels that fit onto tracks running beneath the centrifuge outlet. The Dempster containers move under the centrifuge outlet to be filled and are then picked up by the collection

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*Mention of a specific product or equipment does not imply endorsement by the U.S. Public Health Service.

truck. After being emptied, they are stationed near the tracks until they are needed. When needed they are pulled onto the track by the overhead crane with some guidance from the driver of the collection truck. A heavy crust of sludge forms around the sides and tops of the storage containers. This crusting decreases the capacity and detracts from the appearance of the containers. To remedy this situation, the truck driver periodically cleans the containers.

Waste Collection

The foundry owns two collection vehicles: a 6-cu-yd dump truck to collect wastes from the cupola and sand reclamation storage areas, and a LFW Series Dempster Dumpster to collect the wastes from the settling basin. There is one driver, who operates the vehicles as the need for waste collection at each storage area arises. When the waste collection vehicles are inoperable, the foundry employs a contract hauler. Occasionally, when vehicles and driver are not needed for waste collection at the foundry, they are made available to other areas of the plant.

All sand and slag wastes are collected in the open dump truck. Cupola wastes are shoveled into the open bodied truck with a small front end loader and/or a bucket suspended from overhead. Sand reclamation wastes are dumped from their containers into the open bodied truck. This operation requires two persons--a crane operator

and a man on the ground to attach the container to the hoisting chain. The containers are lifted and emptied into the open truck by swinging the bins against the side of the truck causing them to flip over.

The Dempster vehicle is used to haul sludge waste from the settling basin to the waste disposal site. Collection involves transporting one 3-cu-yd container to the site and back on each trip.

Wastes from all three areas are not picked up regularly, but as demand requires. The dump truck makes about eight trips a day to the disposal site and the Dempster Dumpster makes three trips.

Disposal Sites

The foundry uses three land disposal sites. The Radio Corporation of America (RCA) owns one, and the Cincinnati Milling Machine Company owns the other two. All three are located near Duck Creek Road between Lester Road and Ridge Avenue in Cincinnati, Ohio, a round trip distance of about 3 miles to each. The RCA site is available 5 days a week from 8:30 am to 3:30 pm. The company sites are open any time they are needed.

The RCA site is accessible from Lester Road and is open to the foundry with the stipulation that only dry, inert solid wastes be deposited. Therefore, only cupola and sand reclamation wastes are deposited here. This stipulation is made and enforced by RCA to prevent pest problems from occurring around their plant, which is

located adjacent to the disposal area. The access road to the RCA fill is steep and prevents use of the fill during inclement weather. The disposal site is operated as an area-fill. Wastes are deposited in layers against a hill to raise the grade of the site to the grade of the plant. A bulldozer is used to spread and compact the waste. When completed, this site will be used for RCA parking facilities.

The two company-owned sites are accessible year round from Ridge Avenue by a single dirt access road. The two fills have separate uses: the larger of the two is used for all sandy wastes and the other is used for the sludge wastes.

The sandy wastes deposited in the large fill are dumped at the top of the fill. Although management does not condone the practice, some paper wastes from the food service and vending areas of the foundry are also dumped at this fill daily. The wastes are pushed over the crest of the fill at irregular intervals by a bulldozer. The face of this fill is about 40 ft deep, nearly vertical, and could cave in.

The sludge wastes taken to the smaller fill are dumped out in a flat area adjacent to the fill and allowed to dry for up to 1 year. Each fall the sludge wastes that have built up into large, dried, crusted cakes are broken up and moved by a scraper to the top of the fill where a bulldozer pushes them over the crest. The smaller fill is about 30 feet deep and also has a very steep face.

The fills owned by the Cincinnati Milling Machine Company are equipped with drainage systems to handle surface run-off water. The large and small fills use 48-in. and 56-in. concrete pipes, respectively, and empty into Duck Creek. The drainage systems minimize the amount of water that leaches through the sand wastes and eventually enters Duck Creek.

Cost Data

The total cost of the solid waste management system was not available for the foundry, but some cost information for the operation of their collection vehicles has been developed. The cost of the Dempster Dumpster, including personnel, maintenance and repairs, and depreciation, was $10,639.88 for 1967. Based on 4,641 cu yd hauled during that year, the average cost of waste collection was $2.29 per cu yd.

During 1967, the cost of the dump truck, including personnel, maintenance, repair and depreciation, was $8,222.72. It hauled 8,580 cu yd for an average unit cost of $.96 per cu yd. The average combined cost of the dump truck and dempster dumpster was $1.43 per cubic yard (1967 CMMCo. report).